**Table S8 - unbalanced internal rxns**

| Reaction Abreviation | | | | | | |
|---|---|---|---|---|---|---|
| [2Fe-2S]_FORM | charge: -2 | | | | | |
| [4Fe-4S]_FORM | charge: -2 | | | | | |
| 16S_rRNA_FORM1 | N: 1 | H: 1 | | | | |
| 16S_rRNA_FORM2 | N: -2 | C: -1 | O: 1 | | | |
| 16S_rRNA_FORM3 | N: -3 | C: -1 | O: 3 | H: -1 | | |
| 16S_rRNA_FORM4 | N: -1 | O: 1 | H: -1 | | | |
| 16S_rRNA_FORM5 | N: -2 | C: -1 | O: 1 | | | |
| 16S_rRNA_FORM6 | O: -2 | | | | | |
| 16S_rRNA_FORM7 | N: 4 | C: 1 | O: -2 | H: 2 | | |
| 23S_rRNA_FORM1 | N: -1 | C: -8 | O: -7 | P: -1 | H: -7 | |
| 23S_rRNA_FORM2 | N: 1 | C: 2 | O: 1 | H: 1 | | |
| 23S_rRNA_FORM3 | N: -1 | C: 1 | O: 4 | H: 1 | | |
| 23S_rRNA_FORM4 | N: -1 | C: 1 | O: 3 | H: 1 | | |
| 23S_rRNA_FORM5 | N: 1 | C: 2 | O: 1 | H: 1 | | |
| 23S_rRNA_FORM6 | N: 1 | C: 2 | O: 1 | H: 1 | | |
| 23S_rRNA_FORM7 | N: 2 | C: 1 | H: 4 | | | |
| 5S_rRNA_FORM1 | H: 1 | | | | | |
| 5S_rRNA_FORM2 | N: -1 | O: 1 | | | | |
| 5S_rRNA_FORM3 | N: 1 | C: 1 | | | | |
| 5S_rRNA_FORM4 | N: 1 | C: 1 | | | | |
| 5S_rRNA_FORM5 | N: -1 | O: 1 | | | | |
| 5S_rRNA_FORM6 | O: 1 | H: 1 | | | | |
| 5S_rRNA_FORM7 | N: 1 | C: 1 | | | | |
| 5S_rRNA_FORM8 | N: 1 | C: 1 | | | | |
| Dus_gen_FORMa | S: -4 | N: -7 | C: -33 | O: -13 | H: -25 | charge: 2 |
| Dus_gen_FORMb | N: -2 | C: 8 | O: 1 | H: 1 | charge: -1 | |
| Dus_gen_FORMc | S: 3 | N: 10 | C: 25 | O: 12 | H: 23 | charge: -1 |
| EF-TU_FORM5b | C: -1 | O: -1 | H: -2 | | | |
| ileX_to_ile2 | N: -1 | H: -1 | | | | |
| leuP_to_leu1 | C: -4 | O: -5 | H: -4 | | | |
| leuQ_to_leu1 | N: -1 | C: -4 | O: -4 | H: -5 | | |
| leuT_to_leu1 | N: -1 | C: -4 | O: -4 | H: -5 | | |
| leuV_to_leu1 | N: -1 | C: -4 | O: -4 | H: -5 | | |
| leuW_to_leu1 | N: 1 | C: 14 | O: 14 | P: 2 | H: 17 | charge: -2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| leuX_to_leu2 | C: 8 | O: 10 | P: 1 | H: 11 | charge: -1 | | | |
| leuZ_to_leu2 | S: -1 | C: -9 | O: -11 | P: -1 | H: -11 | charge: 1 | | |
| metY_to_fmet | C: 1 | O: 1 | H: 2 | | | | | |
| proK_to_pro1 | C: 1 | O: 2 | | | | | | |
| proL_to_pro2 | N: -1 | C: 1 | O: 2 | H: -1 | | | | |
| proM_to_pro1 | C: -1 | O: -2 | H: -1 | charge: 1 | | | | |
| proM_to_pro2 | N: 1 | C: -1 | O: -2 | charge: 1 | | | | |
| RNase_Gen_FORMa | S: -1 | N: 130 | Z: 1 | M: -1 | C: 455 | O: 129 | H: 780 | charge: -1 |
| RNase_Gen_FORMb | S: 2 | N: 183 | Z: 1 | M: -2 | C: 616 | O: 197 | H: 961 | charge: -9 |
| RNase_Gen_FORMc | S: 19 | N: 700 | Z: 1 | M: 3 | C: 2537 | O: 749 | H: 3968 | charge: -11 |
| RNase_Gen_FORMd | S: -2 | N: -205 | Z: 1 | M: 2 | C: -682 | O: -202 | H: -1103 | charge: 7 |
| RNase_Gen_FORMe | S: 1 | N: -106 | Z: -1 | M: 3 | C: -387 | O: -123 | H: -636 | charge: 3 |
| RnpBb_RENAME | O: 6 | P: 2 | charge: -2 | | | | | |
| serT_to_ser2 | S: -1 | C: -6 | O: -1 | H: -10 | charge: 1 | | | |
| serT_to_ser3 | S: -1 | N: 5 | C: 8 | O: 4 | P: 1 | H: 10 | | |
| serU_to_ser3 | N: -6 | C: -8 | O: -4 | P: -1 | H: -10 | charge: 1 | | |
| serW_to_ser2 | S: 1 | C: 3 | H: 5 | | | | | |
| serX_to_ser2 | S: 1 | C: 3 | H: 5 | | | | | |
| sink_preQ0 | N: -5 | C: -7 | O: -1 | H: -5 | | | | |
| TEMP_gltT_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_gltU_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_gltV_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_gltW_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_lysQ_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_lysT_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_lysV_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_lysW_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_lysY_tRNA | S: 1 | E: -1 | | | | | | |
| TEMP_lysZ_tRNA | S: 1 | E: -1 | | | | | | |
| thrT_to_thr1 | N: -1 | C: -1 | O: 1 | | | | | |
| thrT_to_thr2 | N: -1 | C: -1 | H: -1 | | | | | |
| thrU_to_thr2 | N: 1 | O: 2 | H: 1 | | | | | |
| thrU_to_thr3 | N: -1 | O: 1 | | | | | | |
| thrV_to_thr1 | N: 1 | O: -1 | | | | | | |
| thrV_to_thr2 | N: 1 | O: -2 | H: -1 | | | | | |
| thrW_to_thr3 | O: -1 | H: -1 | | | | | | |
| tyrT_to_tyr1 | N: 1 | O: -1 | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| tyrU_to_tyr1 | N: -2 | C: -1 | O: 1 | H: -1 | |
| tyrV_to_tyr1 | N: 1 | O: 5 | P: 2 | charge: -2 | |
| valT_to_val3 | C: 3 | O: 3 | H: 5 | | |
| valU_to_val3 | C: 3 | O: 3 | H: 5 | | |
| valV_to_val2 | N: 1 | H: 1 | | | |
| valV_to_val3 | N: 2 | C: -7 | O: -8 | P: -1 | H: -10 |
| valW_to_val2 | N: -2 | H: -2 | | | |
| valW_to_val3 | N: -1 | C: -7 | O: -8 | P: -1 | H: -13 |
| valX_to_val3 | C: 3 | O: 3 | H: 5 | | |
| valY_to_val3 | C: 3 | O: 3 | H: 5 | | |
| valZ_to_val3 | C: 3 | O: 3 | H: 5 | | |